DOCUMENT RESUME

ED 288 302 EC 200 773

AUTHOR Keller, Clayton E.; Hallahan, Daniel P.
TITLE Learning Disabilities: Issues and Instructional Interventions. What Research Says to the Teacher.
INSTITUTION National Education Association, Washington, D.C.
REPORT NO ISBN-0-8106-1076-0
PUB DATE 87
NOTE 36p.
AVAILABLE FROM National Education Association Professional Library, 1201 16th St., N.W., Washington, DC 20036 ($2.50, Stock No. 1076-0).
PUB TYPE Information Analyses (070) -- Reports - Descriptive (141)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Attention Control; Instructional Effectiveness; *Learning Disabilities; Learning Strategies; *Mainstreaming; Metacognition; Mnemonics; Peer Teaching; Student Characteristics; *Teaching Methods
IDENTIFIERS Adaptive Learning Environments Model; Cooperative Learning; Reciprocal Teaching; Teacher Consultants

ABSTRACT

In this research review of basic issues in learning disabilities, definitions, possible causes, prevalence, and identification of learning disabilities are discussed. Characteristics of learning disabled individuals are considered under five headings: perceptual and perceptual-motor disabilities, problems with attention and hyperactivity, cognitive disabilities, social and behavioral problems, and academic disabilities. In general, the learning-disabled individual seems to be a passive, inactive learner who lacks or does not use the strategies for attacking academic problems that the non-handicapped commonly use; in addition, the learning disabled are best thought of as a heterogeneous, rather than a homogeneous, group. Several options are available for administering the education of the learning disabled. One of the most widely utilized instructional arrangements, mainstreaming, may be made more effective by the use of the Adaptive Learning Environments Model, teacher consultants, cooperative learning, and peer tutoring. Several promising, but not well-known, instructional techniques may improve education of the learning disabled; these include reciprocal teaching, self-monitoring of attention, metacognitive self-questioning training, and the keyword mnemonic technique. (JDD)

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What Research Says to the Teacher 8254

ED288302

Learning Disabilities:
Issues and Instructional Interventions

by Clayton E. Keller
Daniel P. Hallahan

EC 200773

A National Education Association Publication

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Daniel P. Hallahan

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ACKNOWLEDGMENT

Some of the work that went into the review of research for this publication was done while the authors were writing a review of research for the West Virginia State Department of Education. That monograph was entitled *Study of Studies for Learning Disabilities: A Research Review and Synthesis*.

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Note

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Library of Congress Cataloging-in-Publication Data

Keller, Clayton E.
Learning disabilities.

(What research says to the teacher)
Bibliography: p.
1. Learning disabled children—Education—United States. 2. Learning disabilities—United States. I. Hallahan, Daniel P., 1944–. II. National Education Association of the United States. III. Title. IV. Series.
LC4705.K45 1987 371.9 87-7919
ISBN 0-8106-1076-0

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BASIC ISSUES IN LEARNING DISABILITIES

Before considering the research on education for learning-disabled students, we shall discuss several topics related to the nature of learning disabilities: (a) definitions of learning disabilities, (b) causes of learning disabilities, (c) the prevalence of learning disabilities, (d) the identification of the learning disabled, and (e) characteristics of the learning disabled.

Definitions

Over the past 25 years, many professionals have offered definitions of learning disabilities; in fact, such definitions are almost as numerous as terms for the learning disabled. Certain factors, though, are common to most of the definitions (28).* Also, certain definitions, either because of their importance or recency, deserve attention.

Common Factors in Definitions

Four factors have appeared in most, though not all, definitions of learning disabilities (28). One factor is the discrepancy between ability and academic achievement. This means that the student is not performing in school as well as would be expected, based on some measure of ability, usually an intelligence test. While this idea of a discrepancy between ability and achievement is probably the most widely accepted of the four definitional factors, it is nevertheless still controversial. Some experts express concern about the measures of ability and achievement, normally standardized tests, used to determine the discrepancy. They question, for example, the psychometric or measurement properties of the tests used or the appropriateness of the test content (see Kavale and Forness [39] for a summary of these criticisms). Opinions also differ on how best to determine such discrepancies and how great a discrepancy should exist for a student to be considered learning-disabled.

The second factor common to many definitions concerns the presumption of central nervous system dysfunction in individuals called learning-disabled. Historically, the field of learning disabilities grew out of research on individuals with known central nervous system damage, such as injuries to the brain, and specific limitations in certain areas, particularly perceptual and perceptual-motor skills, spoken language, and written language, but intact abilities in all other areas (29, 39, 94). Eventually some researchers, studying children with similar patterns of limited and intact abilities but no definite evidence of central nervous system damage, concluded that there

*Numbers in parentheses appearing in the text refer to the Bibliography beginning on page 28.

must be some damage to the system, however minimal. This conclusion resulted in terms such as *minimal brain injury* and *minimal brain dysfunction*. For some practitioners in the field, notably those viewing the issue from a neuropsychological perspective, this assumption is fundamental. Others, however, have difficulty accepting such an assumption, given our limited ability to detect the type of damage presumed and the lack of utility such information has for educational purposes (39).

The third factor often found in definitions is that learning-disabled individuals have psychological processing problems—or difficulties perceiving, interpreting, and using stimuli, especially visual and auditory, involved in academic tasks. Researchers have often noted, though, the limitations of tests designed to identify such deficits (76). Also, the usefulness of instructional approaches based on this idea, such as teaching the student through the strong modality or remediating the processing deficits so that achievement will improve, have not received much support from research (2, 49).

The fourth factor is often called the exclusionary clause. Such a clause states that the learning problems shown by an individual labeled learning-disabled cannot be the result of mental retardation, emotional disturbance, or environmental disadvantage. This sounds like a reasonable and clearcut point and a way to identify learning-disabled students as a group separate from those who might best fit into other categories of exceptionalities or circumstances. However, students in such groups are often behaviorally similar to those identified as learning-disabled (27). There are conceptual difficulties making such distinctions (39). Also, evidence about the ability of educational agencies to make such distinctions is mixed (16, 81).

Three Definitions

The most important definition of learning disabilities to consider is the one used by the federal government. This is the definition that all state and local educational agencies must ultimately abide by:

> "Specific learning disability" means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or of environmental, cultural, or economic disadvantage. (18, p. 65083)

While there is still criticism of aspects of this definition and there is still variation among states in how they define and, especially, implement

different components of it, more states now are following the federal definition than ever before (62, 63).

In 1981, however, several professional groups—the American Speech-Hearing-Language Association, the Association for Children and Adults with Learning Disabilities, the Council for Learning Disabilities, the Division for Children with Communication Disorders, the International Reading Association, and the Orton Dyslexia Society—formed the National Joint Committee for Learning Disabilities to develop a better definition. This committee wrote the following alternative definition:

> Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities. These disorders are intrinsic to the individual and presumed to be due to central nervous system dysfunction. Even though a learning disability may occur concomitantly with other handicapping conditions (e.g., sensory impairment, mental retardation, social and emotional disturbance) or environmental influences (e.g., cultural differences, insufficient-inappropriate instruction, psychogenic factors), it is not the direct result of those conditions or influences. (33, p. 336)

A third definition has been proposed by the Association for Children and Adults with Learning Disabilities:

> Specific Learning Disabilities is a chronic condition of presumed neurological origin which selectively interferes with the development, integration, and/or demonstration of verbal and/or non-verbal abilities. Specific Learning Disabilities exists as a distinct handicapping condition in the presence of average to superior intelligence, adequate sensory and motor systems, and adequate learning opportunities. The condition varies in its manifestations and in degree of severity. Throughout life the condition can affect self-esteem, education, vocation, socialization, and/or daily living activities. (28, p. 97)

The similarities and differences across these three definitions are apparent. The variety of conceptions of the nature of learning disabilities, as seen to some extent in these definitions, reflects some of the controversy that exists in the field.

Possible Causes of Learning Disabilities

Investigators have suggested a variety of factors as possible causes of learning disabilities, including the following:

- genetic factors;
- brain injury (due to physical trauma or lack of oxygen before,

during, or soon after birth);

- biochemicals that are missing (e.g., chemicals necessary for proper functioning of the central nervous system);
- biochemicals that are present (e.g., food additives, such as dyes, or food substances, such as sugars);
- environmental factors, such as lead or fluorescent lighting;
- psychological or social influences, such as cultural differences or disadvantages, inadequate instruction, or poor parenting. (29, p. 17)

While each of these factors *may* cause learning disabilities in a child, there are several important points to remember. Each factor does not necessarily cause learning disabilities whenever present. Nor is one factor necessarily present in every learning-disabled individual. These same factors can also cause other conditions, such as mental retardation or behavioral disorders. It is usually impossible to specify the exact cause in a particular learning-disabled individual. And many of these causal factors are not educationally relevant because teachers and schools cannot target them for interventions. Thus, while there are many important reasons why researchers should investigate the causes of learning disabilities—for example, to better identify children at risk for learning disabilities—many professionals believe that knowledge of causal factors is generally not too important for educators who teach students already identified.

The Prevalence of Learning-Disabled Individuals

The proportion of the general population with learning disabilities is not known; estimates of this proportion, called the prevalence rate, have ranged from 1 percent to 30 percent of the population. Differences in these estimates depend upon factors such as definitions and the amount of discrepancy needed between ability and achievement.

Nevertheless, every year state educational agencies must report the number of school-age children identified as handicapped, including the learning disabled. The federal government then assembles this information into national prevalence rate figures for learning disabilities and the other categories. From the 1976–77 school year, when first compiled, to the 1984–85 school year, the prevalence figures for learning disabilities rose steadily from 1.79 percent to 4.8 percent of the school-age population; no other category has shown such rapid growth. Also during this period, learning-disabled students represented an ever-increasing proportion of students identified as handicapped. Despite many possible explanations, it is still not known why the numbers of the learning disabled are increasing.

The Identification of the Learning Disabled

Related to the prevalence of the learning disabled is the identification of such individuals. Federal regulations specify the procedures to be followed for identifying students as learning disabled (18). A multidisciplinary team that minimally includes (a) the student's general education teacher (or a general education teacher qualified to teach a student of this age if the student does not have such a teacher) and (b) a person qualified to conduct individual diagnostic assessments makes this decision. Such teams also may include the student's parents, other school staff members, district administrators, and even the student. According to the regulations, the student must not be achieving at a level commensurate with ability in one or more of several academic areas. Such a discrepancy may not be due to (a) sensory or motor handicaps; (b) mental retardation; (c) emotional disturbance; or (d) economic, cultural, or environmental disadvantage. Observations are a required part of the assessment procedure. And a written report on the results of the evaluation and the team's decision must be prepared.

Because of persistent problems with identifying learning-disabled students, such as the growing numbers, the possible misidentification of students as learning-disabled, and the difficulties in implementing components of the definition of learning disabilities, a National Task Force was organized by the Office of Special Education Programs, U.S. Department of Education to consider promising procedures and practices to improve identification (15). Based on a national survey, the Task Force summarized practices and offered recommendations for the use of pre-referral activities, teacher support teams, the identification of students at high risk for learning disabilities, team decision making, and transitioning and exiting procedures.

The philosophy underlying these recommendations rests on two points. First, general education should become more involved in the identification process. Second, in addition to special education, a wider range of educational options should be available for students who are having difficulties in school; such options should be tried before starting the special education identification process.

The use of pre-referral activities as recommended by the Task Force exemplifies these points (15). Pre-referral activities involve the organized and systematized efforts of a school staff to help a student who is having problems in school prior to, and, it is hoped, instead of, a referral for possible special education services. The Task Force recommends that the leadership for the use of a pre-referral system in a school district come from the superintendent and be delegated to the building principal in each school instead of being held solely by special education staff. Three general ways to implement the system within general education classrooms involve the use of (a) alternative instructional methods or interventions

implemented by the classroom teacher, (b) a teacher consultant model to provide support to the efforts of the classroom teacher (the teacher consultant model is also discussed in the section on mainstreaming), or (c) a team teaching model. If such pre-referral activities do not help a particular student's problems in school, then a referral is made for possible special education services.

Another national committee, the U.S. Department of Education Special Education Programs Work Group on Critical Measurement Issues in Learning Disabilities, also addressed measurement issues in learning disabilities, especially in terms of how best to measure the discrepancy between student ability and achievement (72). It recommended the use of a regression-based formula—a mathematical equation that takes into account the relationship between tests of ability and achievement before calculating the difference between measures of ability and achievement, as the best method for determining this necessary identification component.

Numerous authorities, however, believe that the use of formulas to identify learning-disabled students is an inappropriate and dangerous practice. The Council for Learning Disabilities, one of the largest professional organizations in the field, in fact opposes the use of discrepancy formulas to identify learning-disabled individuals, citing problems with (a) assessment instruments used to provide scores for the formulas, (b) the discrepancy concept relative to the nature of learning disabilities, and (c) the way discrepancy scores are often used by school districts (5). The Council recommends the use of comprehensive diagnostic evaluations for the identification of the learning disabled. If discrepancy formulas must be used, it recommends the use of a graduated regressed standard score method, the results of which are cautiously interpreted as just one, and not the sole, piece of information about an ability-achievement discrepancy (5).

Characteristics of Learning Disabled Individuals

This section discusses the characteristics of learning-disabled individuals under five headings: perceptual and perceptual-motor disabilities, problems with attention and hyperactivity, cognitive disabilities, social and behavioral problems, and academic disabilities. There are two cautions to keep in mind about this arrangement. First, any individual with learning disabilities will not necessarily, and most likely will not, have difficulties in each of the areas discussed. Researchers in the past tended to look for a "single syndrome" that was *the* basic factor or *the* cause behind the problems of all learning-disabled individuals (41, 57). They would compare the performances of a group of learning-disabled individuals and a group of

nonhandicapped peers on some task or test related to their theory about learning disabilities; if they found differences between the groups, usually with the learning-disabled group doing more poorly, they felt there was some support for their theory. Such research designs mask the variability of the performance of individuals within the group; not all of the learning-disabled students will do poorly on the research task, but, on the average, the group will. Currently, most professionals consider the learning disabled to be a *heterogeneous population*, that is, a group that shows much diversity (41, 57).

Second, individuals (a) with other handicapping conditions, especially the mildly/moderately mentally retarded and the behaviorally disordered (27), (b) not identified as handicapped but having difficulties in school, and (c) with no problems in school commonly exhibit some of the difficulties about to be discussed. Thus the presence of one of these problems does not in and of itself mean the person is learning-disabled. This observation supports the view that the learning disabled cannot reliably and consistently be distinguished from those with other or even no handicapping conditions.

Perceptual and Perceptual-Motor Disabilities

Individuals with learning disabilities may have problems with visual, tactual (touch), or kinesthetic (movement) perception, and/or visual-motor coordination. (The section on spoken-language problems that follows covers auditory perceptual problems.) In such cases, the individual's senses are physically adequate to receive the appropriate stimuli from the world; however, he or she cannot adequately organize, interpret, or use the stimuli received.

For example, in terms of visual perception, a learning-disabled student may have difficulty perceiving the form of stimuli, such as letters, or discriminating among different forms, such as distinguishing *R* from *P* (29). A learning-disabled student may also misperceive the position of the stimuli in space—for example, reversing letters or words, such as reading "was" for "saw." While many children have similar problems at times, especially when first encountering the stimuli, learning-disabled individuals may continue to have difficulty with these tasks over time.

Tactual perception difficulties, which are often linked with kinesthetic perception problems, are connected by some theorists with problems with (a) *body image*, one's awareness of one's body, especially the relationships of its parts and their positions in space; and (b) *laterality*, the awareness of the right and left sides of one's body (29). Problems with visual-motor coordination reflect difficulties combining visual information with motor skills to make the gross or fine motor movements needed for a task; illegible handwriting is sometimes a result of visual-motor coordination difficulties.

The perceptual and perceptual-motor problems of the learning disabled were an early and important focus of researchers' attention (29, 94); some suggest such problems still provide the major way of looking at learning disabilities (39).

Problems with Attention and Hyperactivity

Attentional problems and hyperactivity show a strong relationship: virtually all children diagnosed as hyperactive have difficulties with attention, while most, though not necessarily all, children with attentional problems show indications of hyperactivity (29). Although exact prevalence figures do not exist, most professionals believe that problems with attention and hyperactivity are found at a higher rate in learning-disabled individuals than in the general public.

Keogh and Margolis (42) suggest there are three general areas in which the learning disabled may show attentional problems:

1. Coming to attention. Learning-disabled students often have difficulty focusing attention on the requirements of a task so they can start properly. Partly this involves problems with selective attention, that is, the ability to focus on the relevant aspects of a task or stimulus while not being distracted by the irrelevant components (29, 32). For some students it also involves difficulties deciding which information in a task or stimulus is important and which is not.
2. Making decisions. Some learning-disabled students tend to make decisions impulsively rather than reflectively; that is, they are more likely to make decisions or give answers to problems based on the possibilities they first generate rather than carefully considering various alternatives before responding.
3. Maintaining attention. Some learning-disabled children have more difficulty sustaining attention on a task once it has begun (70). And their performance on such tasks often deteriorates rapidly over time.

But even learning-disabled students with attentional problems are not inattentive in all situations. Krupski (46) suggests some other factors, task demands and setting demands, that interact with the learning-disabled child's abilities and might account for some of the differences in attention. Learning-disabled students tend to perform more poorly on tasks such as academic work that require voluntary attention—active efforts at attention. Learning-disabled children tend to be more on task in situations that require only involuntary, or less active, attention—for example, watching television or engaging in free play. Also, children with attentional problems have more difficulties in structured settings, such as school, where on-task behavior is expected, than in less structured situations, such as free play.

Cognitive Disabilities

The examination of cognitive disabilities—or disorders of memory and thinking—is one of the major lines of learning disabilities research today; many of the educational interventions highlighted later in this monograph are aimed at such problems. Such research has focused on three general topics: cognitive styles, memory, and metacognition.

The earliest research in this area investigated the cognitive styles of the learning disabled (29). Cognitive style—or the way an individual tends to approach a problem-solving task—is thought to be a personality trait and thus relatively consistent across situations.

One dimension of cognitive style is field independence versus field dependence, which considers the extent to which one is influenced by environmental clues on perceptual tasks. Those who are field independent focus more on essential perceptual stimuli, and less on details in the environment (the field), and thus perform the tasks more accurately. Those who are field dependent make more use of environmental details when performing the tasks, and so have a greater chance of being misled. Research has shown that learning-disabled children tend to be more field dependent than their nondisabled peers (4).

Another dimension of cognitive style is reflectivity versus impulsivity (29)—or the extent to which one takes time to think before responding to difficult tasks. Reflective individuals tend to respond more slowly but more accurately; impulsive individuals show the opposite pattern—that is, quicker but less accurate responses. Learning-disabled students as a group tend to be more impulsive (4).

Much research also has been conducted on the memory abilities of the learning disabled, and it has consistently led to three conclusions (29):

1. Learning-disabled individuals tend to have more difficulty remembering information seen and heard.
2. Learning-disabled individuals' memory problems seem to be due to their failure to use strategies to help them remember information—for example, (a) rehearsal, the repetition of the names for what is to be remembered, and (b) organization, the grouping of stimuli into categories.
3. When learning-disabled individuals are taught to use strategies for remembering, their performance on memory tasks is similar to that of their nonhandicapped peers.

Metacognition is the third general area investigated as a source of learning-disabled students' difficulties with memory and thinking. This refers to (a) one's awareness of the mental resources needed for any given task and (b) the self-regulation of those resources as they are used to

perform the task (3). Learning-disabled individuals tend to show deficits in metacognitive abilities in three areas:

1. For memory tasks, learning-disabled students often have difficulty both relating the strategies they would use to remember information and thinking of several different strategies to help them remember (87).
2. Learning-disabled children tend not to monitor very well what they are listening to. For example, they might have difficulty determining whether they had heard enough information to know how to play a new game they were being taught (45).
3. In terms of reading, learning-disabled students often have problems with the following metacognitive strategies:
   a. Determining the purpose of reading a particular piece of writing;
   b. Focusing on the main points of the writing;
   c. Monitoring their understanding of what they are reading;
   d. Using strategies such as rereading and scanning ahead when difficulties with understanding arise; and
   e. Using information sources, such as context clues or reference books, to help when they do not understand material (29).

Social and Behavioral Problems

Learning-disabled students are at risk for social rejection (10). Possible reasons for such rejection include attentional problems, insensitivity, low academic achievement, problems conforming to social norms (7), and inability to accurately read and comprehend social cues (8). Learning-disabled students also may quickly produce negative first impressions, sometimes solely by their actions (10).

Research has also shown that learning-disabled students often exhibit deviant classroom behavior. Evidence from both teacher ratings and classroom observations indicate that they are less task-oriented and display more inappropriate behavior (58).

Further, researchers have found that there are behavioral subtypes of learning-disabled children (84). Some subtypes do not differ much behaviorally from their nonhandicapped peers while others could be characterized as (a) having mild attention deficits, (b) being withdrawn and dependent, (c) being poorly socialized and prone to acting out behavior, (d) having mild but general behavioral problems, or (e) having serious behavior problems. Behavioral subtype membership is also related to academic achievement over time; though all the subtypes started with similar levels of achievement, those characterized by attention or behavior problems had lower achievement in mathematics and reading after three years than did those representing withdrawn or no atypical behaviors (60).

Academic Disabilities

Academic disabilities can take many forms in the learning disabled. Any given learning-disabled individual may have deficits in one or more areas. Even those who have disabilities in a particular area—mathematics, for example—will not exhibit exactly the same kinds of problems.

Reading Disabilities. Reading problems are the most prevalent form of academic disability among the learning disabled (43, 67). And written-language difficulties are commonly seen in conjunction with reading disabilities.

Learning-disabled children may have difficulties with phonological skills, the skills involved with converting written letters and words into sounds (29). They may have problems learning the sound-symbol relationships for letters. Blending the sounds together to make words may be a difficult task, as might be segmenting words into their component sounds.

Learning-disabled students may also have problems using and understanding the grammatical structure or syntax of written language (29). Deficits in syntactical skills limit one's ability (a) to make reasonable predictions about the types of words (e.g., noun or pronoun versus verb) that might next appear in a text and (b) to cluster words in sentences into phrases—two skills that are important for reading efficiency, fluency, and rate.

Finally, the learning disabled often have difficulties with reading comprehension. These problems are often but not always based on their problems with decoding (the phonological and syntactical skills mentioned above) (29). In addition, their difficulties with reading comprehension may result from not using metacognitive abilities to monitor their understanding of what they are reading and adjusting their strategies accordingly.

Researchers have also considered the possibility that there are subtypes or groupings of reading-disabled students who show patterns of abilities similar to and different from those of other subtypes (57, 74, 77). One possible implication of such research is that the subtypes may perform poorly in reading in different ways and may respond better to some forms of instruction than others. Some preliminary evidence supports these ideas (51, 52).

Spoken-Language Disabilities. Difficulties with spoken or oral language are also common among the learning disabled. Such problems carry serious implications not only for achievement, since much school instruction is language-based, but also for everyday life. The language disabilities of learning-disabled students can take many forms. Generally, however, learning-disabled students have more difficulties using language to express themselves than understanding what is said to them (34, 66).

In the area of phonology or the sound system of a language, learning-

disabled individuals may have difficulties producing the sounds of speech; such problems are not necessarily related to difficulties in understanding speech. Learning-disabled children also often have difficulties blending sounds together to pronounce words, discriminating the differences between sounds heard, and separating words into their component sounds. Research evidence suggests differences in these phonological abilities are related to differences in reading achievement (29).

The learning disabled have difficulties with the syntax or grammar of language, too (29). They tend to produce more grammatically incorrect and grammatically less complex sentences than do their nondisabled peers. They often have difficulty understanding facts about grammar. For example, using standard rules to change words, such as changing singular nouns into their plural forms, can be a problem.

Learning-disabled students have difficulties with the semantics or meaning of language (29). They may have impoverished vocabularies. And they frequently have difficulty naming objects, defining words, and producing antonyms. They often fail to recognize the possible multiple meanings of sentences that are ambiguous.

The learning disabled also tend to have problems using language well in social situations. They have difficulties with such things as adjusting their language complexity to suit the age level of their audience, conversing appropriately by taking turns, and maintaining a conversation (9).

Subtypes of learning-disabled students reflecting different patterns of strengths and weaknesses with syntactic, semantic, and narrative language abilities have been shown to be linked in different ways to reading and mathematics achievement (17). Subtypes with lower narrative language abilities relative to their other language abilities tend to do more poorly academically.

Written-Language Disabilities. Learning-disabled individuals' difficulties with written language are often seen in conjunction with perceptual, reading, and/or spoken language problems. Such difficulties can occur with handwriting, spelling, and composition, either separately or in combination.

Considered separately, learning-disabled students' handwriting may indicate (a) poorly or incorrectly formed letters, (b) problems with spacing, and (c) slow writing (29). In terms of spelling, learning-disabled students often spell fewer words correctly than do their peers (13). Their spellings of more difficult words tend to exclude letters, such as silent "e," which represent spelling rules and aid in pronunciation but are themselves not directly heard (21). They are also more likely than their peers to spell words unrecognizably (12).

Compositional skills represent another area in which the learning disabled have problems (64, 71). Learning-disabled students' writings often

include fewer types of words and less complex sentences.

Problems in one area of written language can also cause difficulties in another area. For example, poor handwriting may cause some letters that correctly spell a word to look like other letters, thus making the word appear to be incorrectly spelled. If handwriting is a slow, difficult process, learning-disabled students may forget how to spell the word they were writing. Problematic, unrecognizable spellings will make the content of a composition difficult to read, even for the writer. Learning-disabled students may thus try to limit their composition vocabulary to words that are easy to spell.

Arithmetic and Mathematics Disabilities. Researchers have traditionally paid less attention to the mathematical abilities and performances of learning-disabled individuals than to their abilities in other academic areas (29). However, a substantial proportion of these students do have difficulties with mathematics (61, 67), and instruction in this subject takes up a sizable portion of the teaching time in special education resource rooms (14).

Due to this lack of research, not much is known about what the learning disabled tend to do differently than their nonhandicapped peers while solving mathematics problems. We do know that learning-disabled students often have difficulty with the basic math facts (19, 75). There is some evidence to suggest that this is caused by the use of inefficient counting strategies (19, 85).

Automaticity, the ability to perform some simple task such as naming numbers or letters automatically (i.e., quickly and without much conscious thought), may also be at the heart of some students' difficulties with mathematics. Automaticity has been related to proficiency (speed and accuracy) in solving basic math facts (20). Some researchers have suggested that problems with automatization of skills and mathematics in general become more prevalent in learning-disabled individuals as they become older (1).

Learning-disabled children seem to have adequate informal mathematical knowledge—understandings about number, quantity, and calculational skills acquired through everyday experiences before they receive mathematics instruction in school (75). More formal mathematical knowledge seems adequate for the most part, too, except for difficulties enumerating large numbers and solving complex word problems.

Summary

Given the many areas in which the learning disabled can differ from their nonhandicapped peers and the variety of problems they can have in each area, what general, summative statements can we make about the

characteristics of these students? We believe that two characteristics cut across all areas.

First, the learning-disabled individual seems to be a passive, inactive learner (86), who either lacks or does not use, spontaneously and/or efficiently, the strategies for attacking academic problems that the non-handicapped commonly and efficiently use (25, 28, 32). This passivity is evident in many of the preceding descriptions of characteristics. It will also be evident in the later discussion of educational interventions.

Second, the learning disabled are best thought of as a heterogeneous, rather than a homogeneous, group of individuals (41, 57). In other words, thinking of this population as more diverse than similar fits the research evidence better and makes more sense educationally. This is why we think the research on subtyping (57, 74, 77), especially when conducted from an educational perspective or when considering the educational implications of the subtypes, will be so important to the future of this field.

With this basic information in mind, let us now turn to the research on educational issues for the learning disabled.

EDUCATIONAL CONSIDERATIONS FOR THE LEARNING DISABLED

This section discusses three broad topics pertaining to the education of the learning disabled:

1. The administrative arrangements by which learning-disabled students receive instruction from general and special education in school
2. Suggested approaches for improving one of the most widely used instructional arrangements, mainstreaming
3. A variety of teaching interventions for the classroom.

Administrative Arrangements of Educational Services

Standard Arrangements

Some standard ways of providing educational services to learning-disabled students in elementary and secondary schools involve varying proportions of general education in classes that the nonhandicapped attend and instruction from special education personnel (29); the terms for such arrangements may differ from one educational agency to the next but the underlying concepts are the same.

Learning-disabled children receive the least intensive degree of special education help when they receive all their instruction in classes with nonhandicapped peers. In these cases, student progress may be monitored by a special education teacher, who may also act as a consultant to the classroom teacher on how best to meet student needs.

Another educational arrangement involves services outside the general education classroom with an itinerant special education teacher, who travels to two or more schools, according to a schedule. In such arrangements, learning-disabled students usually see the itinerant teacher for short periods of time (a period or two), a few times each week.

When a resource room is used, learning-disabled students receive more special education instruction, though still some instruction in general education settings. In these situations, the students typically see the resource teacher for a few periods each day (rarely, if ever, as much as half of the school day) to receive instruction in the areas that pose the greatest problems. The rest of the time they spend in classes with nonhandicapped peers.

Learning-disabled students in self-contained classrooms in regular elementary and secondary schools receive most, if not all, of their instruction from special education teachers. They may have some classes—such as physical education, music, and art—with their nonhandicapped peers.

The most intensive administrative arrangement of services is a special day or residential school for the learning disabled. In this situation, all the student's instruction comes from special education teachers, and the school itself is separated, either physically or administratively, from regular elementary and secondary schools.

Research Comparisons of Arrangements

Researchers have studied the relative effectiveness of these various settings for students with three of the higher prevalence handicapping conditions (learning disabilities, mental retardation, and behavioral disorders). These efficacy studies have compared general education settings with special education services and different special education arrangements with each other. (See the following for major reviews of this research: Carlberg and Kavale [11], Leinhardt and Pallay [48], Madden and Slavin [53], Semmel, Gottlieb, and Robinson [80], and Sindelar and Deno [82].)

Generally the studies reviewed tend to find that more intensive special education services are more beneficial for the learning disabled in terms of academic outcomes than are less intensive ones. Some considerations are important to remember before accepting these general conclusions at face value, however. Most important, efficacy studies tend to have problems in the way the research is carried out, problems that limit one's ability to make definite conclusions about what is best (28, 80). Also, relatively few efficacy studies involved the learning disabled. Most were conducted in the early-to-mid-1970s. It may be that current models of providing less intensive services, such as the approaches to mainstreaming described in the following pages, are now more appropriate and that the outcomes of efficacy studies conducted today would show different patterns of results.

In some studies, service arrangements were compared but different instructional methods and approaches were used in each; thus any differences in results may not be the result of the setting per se but of what is happening instructionally within the setting. The importance of physical settings and administrative arrangements may be oversimplified or overestimated if information about instruction is not studied at the same time (47). For example, some instructional techniques for the learning disabled may work best in less intensive settings while others are more effective in more intensive placements.

Thus, based on the existing research evidence, we find it difficult to accept claims that one administrative arrangement of educational services is consistently better than another in terms of academic achievement for learning-disabled students. We think it is more useful to focus on the effectiveness of the instructional methods that are used with learning-disabled students and to consider the question of physical placement in terms of whether certain placements facilitate or limit different effective instructional techniques.

Approaches and Methods to Improve Mainstreaming

Mainstreaming occurs when handicapped students, such as the learning disabled, receive instruction in regular education classrooms with their nonhandicapped peers. Professionals or educational agencies may differ about the proportion of the school day that must be spent in regular classrooms for the arrangement to be called mainstreaming—some accept as little as one class, while others require half or more of the school day—but the basic concept underlying the definition is generally agreed upon and widely implemented. According to recent government information, about 75 percent of U.S. students identified as learning-disabled receive at least some of their instruction in regular education settings (88).

The following pages discuss several approaches and methods that may have a positive impact on the education learning-disabled students receive in mainstream settings.

The Adaptive Learning Environments Model

One approach to mainstreaming that has been implemented in full or in part in many school districts is the Adaptive Learning Environments Model (ALEM) (90, 91, 92, 93). This model has been used with many different types of special education students, including the learning disabled, as well as the gifted.

The academic and social skills of all students in the classroom, handicapped and nonhandicapped, are the targets of ALEM. One of its major components, prescriptive learning, is based on the teaching effectiveness literature in general education (e.g., Glaser [23], Rosenshine [73]). This structured instructional component frequently diagnoses student progress and adjusts the pacing of instruction to individual needs. It can either adapt the curriculum materials normally used in the school or use individualized curricula developed by the researchers. The other major component of ALEM focuses on self-responsibility. It uses less-structured, more exploratory techniques, such as having students plan and manage their learning activities, to meet its goals.

ALEM may be a good model for mainstreaming learning-disabled students. It has been well thought out and developed; it has been implemented in many settings. Though much research has been conducted to see if (a) a greater degree of implementation of ALEM is related to positive student outcomes and (b) ALEM is more effective than resource room special education services, the results, which support ALEM, should be considered only suggestive at this time. Problems with the methods of conducting the research prevent definite conclusions. In addition, more information is needed on how the programmatic aspects of ALEM are implemented.

Teacher Consultants

The idea of using special education teachers as consultants to general education teachers, though suggested much earlier, became more established in the early 1970s as some colleges and universities started offering formal teacher consultant training programs. Using competency-based training of the consultants, these programs tend to emphasize applied behavior analysis techniques to monitor the effects of interventions on behavior. These techniques rely on frequent and direct collection of data on student performance to measure change (40).

Teacher consultants provide supportive services to classroom teachers with handicapped students (35, 36). Such support could include academic and behavioral assessment, help in setting up systems to manage student behavior, and instruction in using data on student performance to guide instruction. A variety of professionals—special education teachers, school psychologists, guidance counselors, social workers, and administrators—could serve as teacher consultants.

There are many reasons why teacher consultants may be a good way to provide special education services and support mainstreaming for the learning disabled (36). Consultation is an efficient way to deliver services as more special education students are provided services and classroom teachers learn techniques that can be used with all students. It is a flexible approach that directly involves school staff and parents in the handicapped student's programming. It can thus help prevent some school problems.

Some evidence does support the effectiveness of teacher consultation as a means of improving academic and social skills (e.g., Idol-Maestas [35], Knight and others [44], Nelson and Stevens [65]). It is difficult to tell, however, whether the teacher consultant model per se or the techniques used by teacher consultants, such as applied behavior analysis, are responsible for the positive research results. A number of problems also must be faced if a teacher consultant model is to be implemented widely and appropriately (24). Such problems include (a) an insufficient description of the duties of the teacher consultant, (b) lack of administrative support in terms of adjusting caseloads and duties for teachers who do consult, and (c) further legitimization of the teacher consultant role by state educational agencies and teacher training institutions.

Cooperative Learning

Cooperative learning involves small groups of students, usually with a range of abilities, working together and cooperating in order to achieve a goal. Many investigations have focused on the impact of cooperative learning situations on both (a) the attitudes of nonhandicapped students toward their handicapped, including learning-disabled, peers and (b) the achievement of handicapped and nonhandicapped students.

Research on the effects of cooperative learning on attitudes is very encouraging. Some researchers believe cooperative learning helps nonhandicapped students develop nonstereotypic, more realistic views of their handicapped peers (37). Nonhandicapped students learn when and under what conditions aspects of handicapped students' conditions are relevant or irrelevant.

Two extensive reviews of cooperative learning research found strong evidence that cooperative learning is more effective than interpersonal competition and individualistic efforts in increasing achievement (38, 83). Two elements seem critical to the success of cooperative learning on achievement, however: (a) group incentives for the improved performance of all members of the learning group and (b) individual accountability for performance (83).

Peer Tutoring

Peer tutoring—one student helping another student learn academic material—has been recommended as a way of integrating handicapped, including learning-disabled, and nonhandicapped students. Handicapped students have been suggested as both tutors and tutees.

Reviews of several studies indicate that academic skills of learning-disabled students can improve when they serve as either tutors or tutees (68, 79). The effects of peer tutoring on personal/social outcomes have not been as encouraging, though investigators have not often considered these outcomes for tutees. Thus, there is a possibility that the behavior of tutees does change, but has yet to be documented. Research that has considered the effects of peer tutoring on aspects of the social/personal development of learning-disabled tutors tends to find no improvement (68, 79). Also, there is virtually no research support for the idea that peer tutoring is a time-saving or cost-efficient method of instruction, given the teacher efforts needed to set up and maintain such a system (22).

Thus, peer tutoring can positively influence both tutor and tutee academic skills, while its effects on social outcomes are still, to some extent, indefinite. Also, peer tutoring has not been compared with other types of teacher-led instruction, which would provide a strong test of its usefulness. If a peer tutoring system is implemented, research indicates that the tasks involved need to have a high degree of structure, while the responses required of tutees need to be simple. The teacher should consider whether or not tutees will be positively affected by peer modeling and peer-delivered reinforcement. Prospective tutors should be carefully trained for their role. The teacher should also consider whether any particular combination of students as tutor and tutee will tend to produce inappropriate behaviors from one or both students and have plans ready for addressing such behaviors if they arise (22).

Instructional Interventions

A variety of general approaches to instruction have been suggested for use with the learning disabled. Some of the major approaches are process training, multisensory approaches, structure and stimulus reduction, direct instruction, behavior modification, and cognitive behavior modification. Much has been written about these approaches already (e.g., Hallahan, Kauffman, and Lloyd [29], Lloyd [50], Wallace and Kauffman [89]).

We focus instead on several supplementary interventions or techniques that have not received much coverage but, in our opinion, are especially promising. The following interventions—reciprocal teaching, self-monitoring of attention, self-questioning training, and the keyword method—have strong foundations in theory and good empirical support for their effectiveness. They hold promise for improving the educational services provided to learning-disabled students.

Reciprocal Teaching

Reciprocal teaching addresses metacognitive aspects of reading comprehension (6, 69). This intervention trains metacognitive skills, such as summarizing (self-review), questioning, clarifying, and predicting events in the text, that are important for fostering and monitoring reading comprehension. Training occurs interactively, with the teacher and either individuals, pairs, or small groups of students teaching each other.

Reciprocal teaching is based on theories and research on how learning occurs socially, for example, when children learn from their parents or apprentices learn a master's craft (69). The teacher provides a cognitive structure to the learning situation that is occurring socially, continually evaluating the student's understanding and participation to adjust the structure. Regulation of the learning situation's dialogue comes at first from the teacher, but gradually the student assumes more of this responsibility when able to handle it.

In reciprocal teaching, the adult teacher assigns a segment of text to read and chooses someone, either him/herself or a student, to be the teacher for that segment. Everyone reads the segment silently. The teacher chosen then reviews what was just read, clarifies any problems, asks a question about the material, and predicts what will happen later in the text. Then another person becomes the teacher for the next segment and the process continues.

The reciprocal teaching technique has worked well in both one-to-one situations and in small groups (69). Students' comprehension abilities have improved not only in reading but also in subject areas that require reading. The improvement has also been durable.

Self-Monitoring of Attention

Self-monitoring of attention is a cognitive behavior modification technique designed to address the attentional problems of learning-disabled students and improve their on-task behavior (26, 30, 31). In the area of on-task behavior, it targets the problem mentioned earlier, namely, that learning-disabled students often do not use task-appropriate strategies spontaneously as do their nonhandicapped peers. The researchers also felt that actively engaging the learning disabled in running the intervention would address the passive learning style exhibited by many of these students.

For this intervention, the teacher first talks with students about their problems with paying attention and suggests a way they can help themselves. An audiotape, playing tones at intervals from 10 to 90 seconds apart, averaging about 45 seconds, cues students to ask themselves the question "Was I paying attention?" Students mark their answers on a recording sheet on their desks. They return to their work, repeating the procedure whenever they hear a tone.

As part of the training, the teacher models the use of the procedure. Students then try it themselves, with feedback and corrections from the teacher as needed. The whole training procedure usually requires only one 20-minute session, though reviews during the first few days of the intervention may be helpful. Later, as on-task behavior improves, the use of the audio cues can be removed ("Whenever you think of it, ask yourself the question 'Was I paying attention?'"). Eventually the self-recording component can also be stopped. It is better if self-monitoring is implemented without the use of reinforcements; however, if they are needed to ensure the use of the procedure, they can be used and later withdrawn.

Researchers have found the procedure can be used successfully during (a) individual seatwork, (b) small group instruction in resource rooms, and (c) individual seatwork situations within regular classrooms (26, 30). It increased attentional behavior and, to a lesser extent, academic productivity. It was used during reading, spelling, handwriting, and mathematics work, and was effective for a wide variety of learning-disabled students.

Self-Questioning Training

Self-questioning training is a cognitive behavior modification intervention used to improve reading comprehension (95, 96). Questions are generated either by the student or by others to imitate the self-monitoring role of metacognition during reading as a way of supplementing the learning-disabled student's deficiencies in metacognition. This permits the student to use his or her knowledge and intact strategies to comprehend what is being read.

The basis for this procedure draws upon some of the same research and conclusions behind self-monitoring of attention. Particularly important are the conclusions that in many cases learning-disabled students possess the cognitive abilities and knowledge necessary to perform tasks successfully but, because of deficiencies in metacognition, do not use them (95). Therefore if one can improve these metacognitive deficits, by instruction or the provision of metacognitive strategies, one can help learning-disabled students use their already-present abilities, resulting in improved performance in domains such as reading comprehension.

The self-questioning strategies mimic the self-regulation aspect of metacognition. The teacher trains the student to ask questions or make statements such as: "What do I have to do?"; "Find the main idea/ideas in the paragraph and underline them"; "Think of a good question about the main idea"; "Check my work."

Teachers have successfully used self-questioning to help learning-disabled students (a) recall main ideas, (b) recall sentences in a text in which the consequences of an action were either explicitly or implicitly stated, (c) monitor comprehension, and (d) activate prior knowledge to aid comprehension (95, 96).

Keyword Method

The keyword method is one example of a general group of interventions called mnemonic techniques that provide systematic procedures to improve the remembering of information (54). Evidence suggests this strategy is an effective way to help learning-disabled students recall information taught in school.

The keyword method has three components (54):

1. The recoding component transforms an unfamiliar piece of information into a keyword that sounds similar to the information to be remembered and can be easily visualized.
2. An image of the keyword combines with an image from the information in some interactive picture that will later be recalled—the relating component.
3. The retrieving component provides a recall strategy: Remember the keyword, remember its image, and retrieve the information to be remembered from the interactive picture.

To use this method, the teacher provides the keyword for the item to be learned and, usually, cards showing the interactive picture; or students may generate their own mental images of the interaction. The interactive pictures can also have multiple components to represent multiple facts. In a structured, directed way, the teacher trains students to use the three components of the method.

For example, one study used the keyword method to help students remember information about minerals (78). One image from that study used a picture of a black wolf on a floor with light bulbs nearby. This image was designed to help students recall that the mineral wolframite (wolf was the keyword) is black, has a hardness rating of four (floor served as a pegword for four, that is, a rhyming word that recodes a number), and is used in light bulbs.

This technique has been used to help learning-disabled students remember facts about minerals (55, 78) and vocabulary (56).

CONCLUSION

We have presented many of the important facts for understanding learning disabilities and treating them in schools. This information represents just a part of the knowledge base about learning disabilities, however. This base is constantly growing as researchers continue not only to find different aspects of the condition to investigate, but also to develop, implement, and evaluate new ways to improve the education of the learning disabled. Will we ever have a complete understanding of learning disabilities? Possibly, but until we start approaching such an endpoint, and perhaps even then, we need to accept the diversity that learning-disabled individuals represent and the ambiguity about our knowledge of learning disabilities resulting from such diversity.

But, as teachers and parents know only too well, regardless of the incomplete and diverse information base about learning disabilities, we still need to teach the learning disabled every day and in ways that are maximally effective if these students are to make headway against their problems. We need to use evidence established by research to help us understand learning disabilities in general, and we need to gather specific information about any learning-disabled students we teach to identify their individual needs and to plan instruction for them. We also need to frequently collect information—not just opinion—on whether the instructional content and methods we use are effective for these particular individuals, and adjust our teaching accordingly. We believe, then, that an information-oriented, research-based approach to instruction will best help learning-disabled students achieve their potential.

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